free of attachment when adult, yet occasional examples have a larger, strong attachment, and remain fixed up to adult size. This is also the case with the West American *E. californica* Dall.

The typical form of *E. arcinella* is the West Indian race with many (about 16 ±) spinose radial ribs, the spines profuse, slender and tubular. In the same lots there occur specimens with the spines mostly reduced to nodules on the ribs, which remain numerous.

The Florida race of *arcinella* (Pl. 7, fig. 7, Gasparilla I.) has fewer radial ribs, usually 7 to 9, and generally stouter, shorter spines. If a valid subspecies it will bear the name *Echinochama arcinella cornuta* (Conrad). The Pliocene specimens are rather intermediate between these races, as might be expected.

In some places, as in the south end of Lake Worth, only small ones, about 20 mm. long, have been found. A large valve from the near-by ocean beach measures 57 mm.

We regret that the photograph is poor, not showing the pitted intercostal sculpture.

THREE NEW SUBSPECIES OF *HELMINTHOGLYPTA ARROSA* (GOULD)

BY ALLYN G. SMITH

Recent investigation into the variation of the common northern California land snail *Helminthoglypta arrosa* (Gould) leads to the conclusion that there are at least three races so different from any of those already named as to warrant description. They are as follows:

HELMINTHOGLYPTA ARROSA WILLIAMSI, new subspecies. Pl. 8, figs. 1, 2, and 3.

Diagnosis: Shell of medium size for the species, thin; spire high in relation to the diameter, which gives the shell an unusually elevated appearance, the apical angle being about 95°; whorls 6¾, closely coiled, the last globose, descending sharply from the suture to a point near the periphery, below which it is well-rounded, terminating in a subcircular aperture; lip simple, not thickened; peristome only slightly reflected except at its basal termination, where it partially covers the umbilicus; terminations of peristome connected with a thin callus wash. Umbilicus small,

contained about 13 times in the major diameter of the shell. Nuclear whorls nearly 2, smooth but not glassy. The sculpture of the post-nuclear whorls consists of low, irregular growth-ridges, which, on the upper portion of the last three whorls, are cut into round or somewhat elongated granules following a general spiral arrangement. These granules become obsolete below the periphery of the body whorl and disappear in the vicinity of the umbilicus and within it, giving the base of the shell a more polished appearance than the upper portion. Color, cinnamon-brown to buckthorn-brown, with occasional short irregular streaks or flecks of lighter color, encircled with a narrow but well-defined band of liver-brown. The above is a description of the holotype, a fully mature specimen that measures: max. diam. 25.6; min. diam. 21.0; alt. 20.6 mm.

Holotype: Cat. No. 7204, Calif. Acad. Sci. Type Coll. *Type locality:* Hog Island, a small islet in Tomales Bay, Marin Co., California. The type lot consists of about 100 shells collected in 1936 and 1937 by Woodbridge Williams, for whom the subspecies is named. *Paratypes:* Specimens so designated have been placed in the collection of the California Academy of Sciences, the Academy of Natural Sciences of Philadelphia, the Los Angeles Museum, the San Diego Society of Natural History, and in the private collections of Dr. S. S. Berry, E. P. Chace, W. Williams, and A. G. Smith.

Remarks: This unusually high-coned subspecies of *arrosa* is distinguished by the entire absence of malleations that are present on all other forms of this species that have been described. Individuals range in altitude from 18.1 to 23.1 mm., and in maximum diameter from 22.8 to 28.3 mm. An extremely tall shell measures 23.1 × 25.0 mm. (h/d), while a low-coned shell measures 18.1 × 22.8 mm. The number of whorls varies between $6\frac{1}{4}$ and $7\frac{1}{8}$, the average being $6\frac{3}{4}$. The umbilicus is partly covered normally although in one individual it is entirely open, and in another it is almost completely closed. The nuclear whorls of the holotype are somewhat worn but on another specimen there is a faint suggestion of the wrinkled structure normal in *arrosa* and its described subspecies.

Williamsi is related most nearly to *H. a. stiversiana* (J. G. Cooper), from which it is distinguished by smaller size, much darker color, and lack of malleations. It has the high cone of

H. a. miwoka (Bartsch), but is a larger, dark-colored, and smoother shell. The shells are found under brush and weeds on the lower slopes of the island. Although the colony is a strong one at present it could be severely decimated, if not completely wiped out by indiscriminate collecting. It is therefore sincerely to be hoped that this will not occur, for this form probably exists nowhere else, and it represents an interesting variation in an extremely variable species of California land snails.

HELMINTHOGLYPTA ARROSA POMOENSIS, new subspecies. Pl. 8, figs. 4, 5, and 6.

Diagnosis: Shell large and heavy; spire low, with an apical angle of 130°. Whorls $6\frac{3}{4}$, the last large, full, and evenly-rounded. Aperture subovate; lip simple, not thickened, the upper part descending slightly from the horizontal axis of the shell, hardly reflected above but more so at the periphery and along the basal portion, the amount not being especially prominent. Umbilicus 0.4 mm. in diameter, permeable to the apex, cylindrical, only slightly covered by the basal reflection of the peristome. Nuclear whorls $1\frac{3}{4}$, somewhat eroded and not exhibiting any marked structure. The first two and one-half post-nuclear whorls are relatively smooth, marked only by subobsolete irregular growth-ridges. On later whorls the growth-ridges become stronger until on the last whorl they dominate the sculptural characters of the upper part of the whorl above the periphery. Except on the early whorls the growth-ridges are cut irregularly into round or elongate granules, which appear strongest only upon the upper portion of the body whorl. Fine malleations are superimposed on this transverse sculpture at about the beginning of the last whorl and these rapidly become larger until they are the most prominent structural feature of the shell, extending over the periphery and on to the base, where they gradually grow weaker and disappear in the immediate vicinity of the umbilicus. The result of this combination of sculptural characters serves to give the shell a heavily malleate appearance, which, on closer inspection, is also finely granular. The base is highly polished and shining. Color a dark cinnamon-brown, covered with an irregular network of maize-yellow markings that generally follow the raised edges of the malleations. This light-colored network is interrupted in places by occasional stripes of basic ground-color and is lacking also immediately behind the lip and on the early whorls. Shell encircled with a clean-cut, liver-brown band, 1 mm. wide. Color within the aperture reddish-violet, showing the band and other evidences of external coloration. The above is a description of the holotype,

an unusually fine, fully mature individual measuring: max. diam. 39.3; min. diam. 32.1; alt. 25.0 mm.

Holotype: Cat. No. 7208, Calif. Acad. Sci. Type Coll. *Type locality:* Big River, near the mouth of Daugherty Creek, Mendocino Co., California, under redwoods, 2 adults and one broken shell collected May 31, 1930 (A. G. Smith). *Paratype:* A single specimen, so designated, is No. 3929, A. G. Smith Coll.

Remarks: This remarkable subspecies of *arrosa* can be recognized immediately by its huge size, heavy malleations, and unique coloration (for the species) of a yellowish network on a dark background. Other examples of this same race have been collected on the Navarro River at the mouth of the North Fork, and in Russian Gulch, both in Mendocino Co. Apparently it is found only near the coast in heavily timbered redwood canyons and is not common, being found so far in pairs or singly. With it has also been collected a smaller but totally different race close to *arrosa* s.s., with which it evidently does not intergrade.

Pomoensis is not closely related to any other described *arrosa* subspecies. However, *H. arrosa* is so variable, taken as a whole, it is possible that more careful collecting will turn up intergrades between *pomoensis* and a medium-sized, low-coned race of *arrosa* referable to the subspecies described as *rubicunda* (Rowell).[1]

An indication of the large size of the adult specimens collected may be obtained from the following table of measurements:

Big River, Mendocino Co.	Diam.	39.3	mm.,	alt.	25.0	mm.,	whorls	$6\frac{3}{4}$.	Type.
	"	40.5	"	"	25.7	"	"	$6\frac{5}{8}$.	Paratype.
Navarro River, Mendocino Co.	"	40.7	"	"	25.5	"	"	$6\frac{3}{4}$.	
	"	36.5	"	"	22.6	"	"	$6\frac{1}{2}$.	
Russian Gulch, Mendocino Co.	"	37.3	"	"	25.1	"	"	$6\frac{3}{4}$.	

Named for the Pomo, a tribe of Indians formerly living in the vicinity where this snail is now found, who may have used it for food.

[1] Rowell described this as a subspecies of *H. exarata,* which is obviously an error as the latter is known only from the Santa Cruz Mts. north to Pescadero, in San Mateo Co. and Los Gatos in Santa Clara Co., California.

HELMINTHOGLYPTA ARROSA MATTOLENSIS, new subspecies. Pl. 8, figs. 7, 8 and 9.

Diagnosis: Shell large, globose, of fairly heavy texture; spire moderately elevated, the apical angle being 113°; whorls 5¾, the last rapidly expanding, effuse and evenly rounded, terminating in a capacious aperture; lip not quite mature and therefore thin, slightly expanded above but more so below, where its basal termination half obscures the umbilicus, connected between terminations by an exceedingly thin wash of callus. Umbilicus rather small for the size of the shell, being contained about 16 times in its major diameter. Nuclear whorls 2, smooth but not shining under a magnification of ×40. Sculpture of the post-nuclear whorls composed of low, irregularly spaced growth-ridges that gradually increase in size until on the last three whorls they become the most prominent sculptural feature. On the body whorl there are several broad malleated areas or bands, extending from suture to base, being wider at the periphery. The last of these areas lies just behind the lip and covers about one-eighth of the body whorl. On this the malleations are large and coarse, but on two similar but smaller areas preceding it the malleations are smaller and finer. The malleated areas are also sculptured with transverse ridges, much lower than the growth-ridges and spaced so closely that from two to six or seven lie between each major pair. These finer ridges are cut by spiral striations that vary considerably in strength but are sufficiently incised to produce a marked granular appearance above the periphery, the granules, where prominent, being much elongated. The spiral striations can be seen only under a magnification of about ×14 and are stronger above than below where they are more closely spaced on portions of the base where they are visible. Color yellow-brown with occasional cinnamon-brown streaks, the most heavily malleated area being of the darker color and marked with lighter colored flammulations. Shell encircled with a clean-cut liver-brown band about 2 mm. wide. The above is a description of the holotype, a fine but recently matured individual measuring: max. diam. 36.7; min. diam. 28.6; alt. 27.2 mm.

Holotype: Cat. No. 7209, Calif. Acad. Sci. Type Coll. *Type locality:* On the coast between Cape Mendocino and the mouth of the Mattole River, Humboldt Co., California, living shells being found among the fallen leaves of madrone trees (*Arbutus menziesii*). The type lot consists of 18 adult specimens, mostly dead and bleached, and 16 nearly half-grown young shells, living when collected. G. Dallas Hanna, coll., June 13, 1928. *Paratypes:*

Specimens so designated have been placed in the collections of the California Academy of Sciences, the Academy of Natural Sciences of Philadelphia, the Los Angeles Museum, the San Diego Society of Natural History, and the private collections of E. P. Chace, Dr. S. S. Berry, and A. G. Smith.

Remarks: It was altogether astonishing to discover another large race belonging to the *arrosa* group at a locality so far north in California, where one would expect to find *H. a. expansilabris* (Pilsbry) or a low-coned form referable to *H. a. rubicunda* (Rowell). In fact, a single dead shell of this latter subspecies was collected along with the larger shells of *mattolensis,* which is at least partial proof that the two occupy the same habitat. No evidence of intergradation is to be seen in the material at hand.

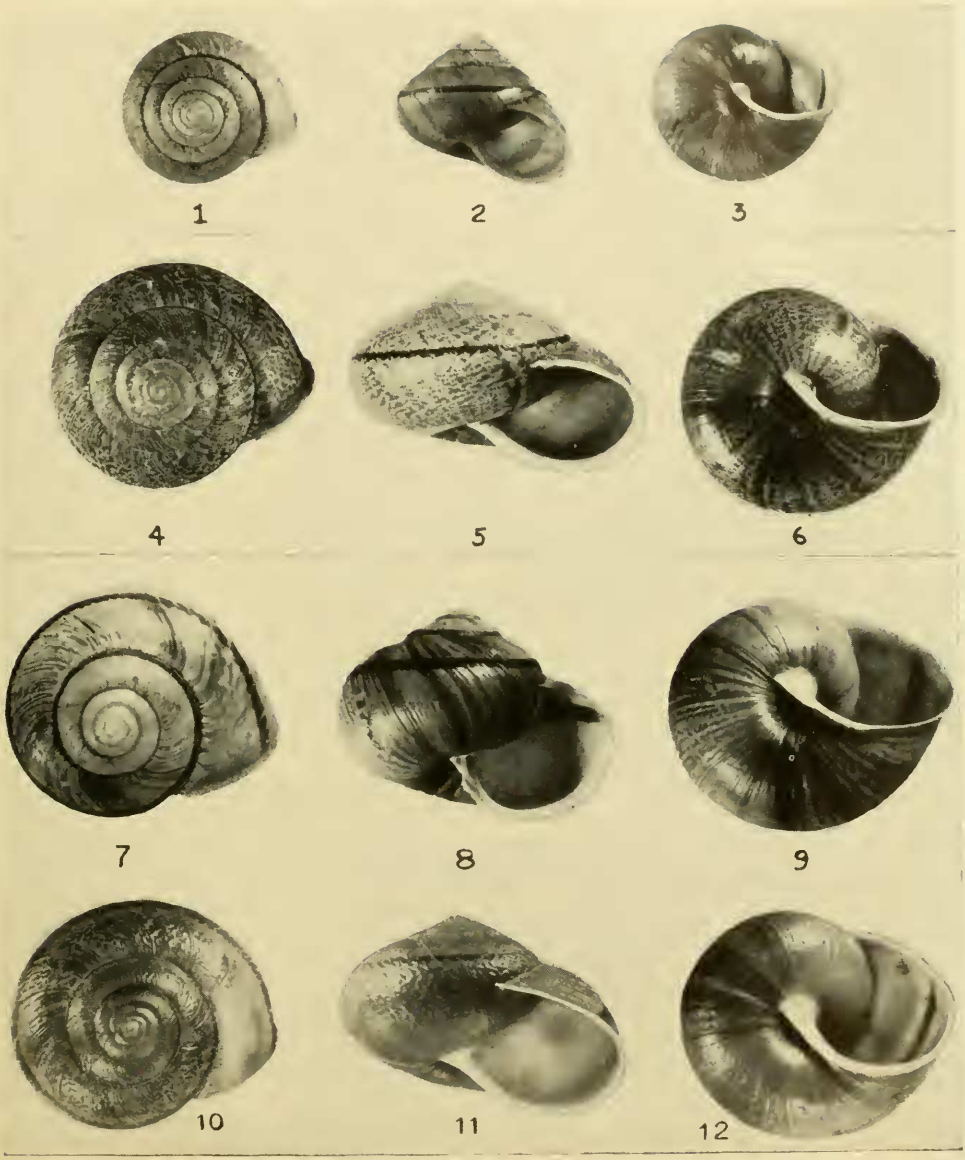
Mattolensis is variable in size, as shown by the following table:

Largest shell	Diam.	38.6	mm.;	alt.	31.2	mm.;	whorls	$6\frac{1}{8}$
Smallest shell	"	29.5	"	"	22.2	"	"	$5\frac{1}{2}$
Average of 18 adults	"	32.9	"	"	25.9	"	"	$5\frac{3}{4}$

The number of whorls ranges from a maximum of $6\frac{1}{8}$ to a minimum of $5\frac{1}{8}$. The umbilicus of most of the shells in the type lot is almost unobscured by the basal reflection of the peristome, while in several it is half covered; one individual is imperforate.

Young living specimens vary in color from light horn to cinnamon-brown, and one has the dark band bordered by broader bands of lighter color. The nuclear characters are well shown in these young shells, the nucleus being semi-polished and generally rather smooth except for a crimping of the shell at the tip and along the suture. The presence of occasional papillations leads to the supposition that embryonic shells may be sparsely hirsute.

This new subspecies of *arrosa* may be recognized at once by its large size, tall spire, and more especially by its exceedingly globose body-whorl and large subcircular aperture. *H. arrosa* s.s. from San Mateo Co. and from the region of Mt. Tamalpais in Marin Co. are equal in size but have an average of one more whorl and do not have as globose a body-whorl. In spite of being at least double the size, it appears to be more closely related to *expansilabris* than to any other described subspecies inasmuch as it has approximately the same ratio of height to major diameter, the



1–3, *Helminthoglypta arrosa williamsi* A.G.S. 4–6, *H. a. pomoensis* A.G.S. 7–9, *H. a. mattolensis* A.G.S. 10–12, *Helminthoglypta tudiculata rex* Church & Smith.